

## *DISCRIMINATIVE PROPERTIES OF PUNISHMENT<sup>1</sup>*

WILLIAM C. HOLZ and NATHAN H. AZRIN

ANNA STATE HOSPITAL

Some stimuli, such as light and sound, may function either as discriminative or as aversive stimuli. The lower-intensity range of such stimuli is generally used to investigate the discriminative property, whereas the higher-intensity range is used to study the aversive property and little attention has been given to its discriminative property. However, one experimenter (Azrin, 1958) has shown that stimuli of such intensity as to be aversive can also function as discriminative stimuli. Azrin presented intense noise continuously during selected portions of a fixed-interval reinforcement schedule; and he found that if the noise had been temporally associated with reinforcement, responding increased during the noise. Conversely, if the noise had been associated with extinction, responding decreased.

This experiment considers the discriminative property of an aversive stimulus in a somewhat different situation. Instead of being presented continuously for a period of time, the aversive stimulus is presented only after a response has occurred. This procedure is the typical punishment paradigm. The occurrence or nonoccurrence of punishment is then selectively related to reinforcement.

### METHOD

#### *Subjects*

Three male, White Carneaux pigeons were used as subjects. They were deprived of food until their weights were 75 to 80 per cent of their free-feeding levels. Controlled feeding maintained the weights of the individual subjects within a 15-gram range during the experiment.

#### *Apparatus*

The experimental chamber is essentially the same as that described elsewhere (Ferster, 1953). The experimental space is 13 by 14 by 15 inches, and it is enclosed within a lightproof, sound-attenuating compartment. The floor of the chamber is an electrically insulated wire grid. The response was a peck on a plastic disc with a force of at least 10 grams, and reinforcement consisted of a 3-second presentation of grain from a feed magazine. All experimental conditions were programmed by standard electrical timing and switching devices located in a separate room. Responses were recorded by electrical impulse counters and a Gerbrands cumulative recorder.

Punishment consisted of an electric shock delivered through electrodes implanted in the tail region of the pigeon (Azrin, 1959). Daily recordings show that the subject's resistance was approximately 900 ohms (measured with a 50-millivolt input) with a range of approximately  $\pm 100$  ohms. Alternating current was delivered to the subject through a 10,000-ohm resistor for  $65 \pm 3$  milliseconds. When shock was not being delivered, the leads were shorted together to avoid shock inductance.

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## RESULTS AND PROCEDURE

The usual procedure for establishing a discrimination is to reinforce all responses in the presence of a given stimulus and to extinguish all responses in its absence. In order to establish punishment as a discriminative stimulus, the occurrence of punishment must be differentially related to reinforcement. For differential pairing, two types of experimental sessions were given each day. One type of session provided both punishment and reinforcement, and the other type provided neither punishment nor reinforcement. Otherwise, the stimulus conditions of these sessions were the same. The order of presentation of the sessions was varied irregularly.

Two subjects were first conditioned to respond on a 2-minute, variable-interval schedule of food reinforcement. Daily 30-minute sessions were given until the response rate stabilized. The cumulative-response record labeled C in Fig. 1 illustrates the high, uniform response rate that characterized performance under this reinforcement schedule. Although the records in this figure are for one subject, the results were essentially the same for both subjects. With responding thus established, punishment was administered to each response in these food-reinforcement sessions. The intensity of the shock was adjusted until a consistent, moderate suppression resulted. A shock intensity of 60 volts A. C. effectively reduced the responding to one-half of the unpunished response level. Record A in Fig. 1 illustrates the suppression of response rate that resulted when the punishment was combined with reinforcement. After responding was established in these sessions that paired punishment and reinforcement, the additional sessions were introduced. The new sessions were 2 hours long, and, as stated above, provided neither punishment nor reinforcement for the subject's response.

After these sessions had been provided for approximately 3 weeks, a consistent response pattern developed in each type of session. Responding in the punishment and reinforcement session maintained the pattern illustrated in Record A of Fig. 1. Responding started slowly and then increased until a moderate rate was reached. This rate then continued throughout the rest of the session. Responding in the absence of punishment and reinforcement reached

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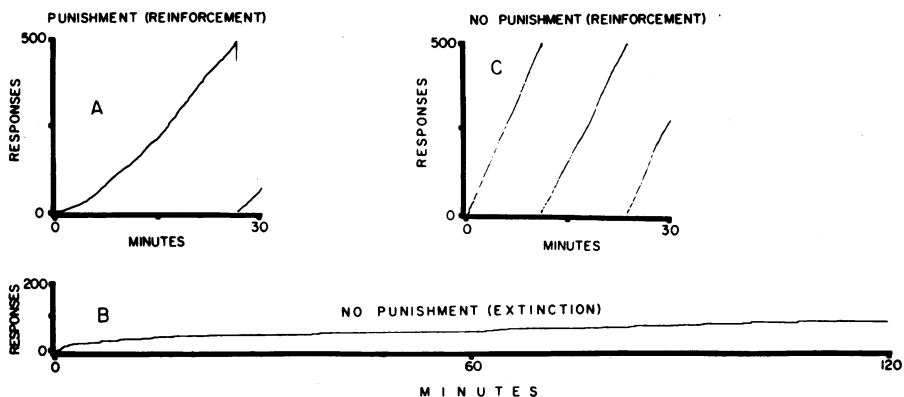


Fig. 1. Response patterns under these conditions: A, punishment and reinforcement; B, no punishment and extinction; C, no punishment and reinforcement.

the pattern illustrated in Record B of this figure. Under this condition, responding was negatively accelerated and invariably reached a near-zero rate after the first half-hour. The rate in these no-punishment sessions continued to fall throughout the experiment; and in one instance, only 11 responses were made in a 2-hour session. The flurries of rapid responding that are often characteristic of extinction had largely disappeared by the end of the third week.

After the 3-week stabilization period, the response rates during the two types of sessions were clearly different. Considerably more responses were emitted in the punishment—reinforcement sessions than in the no-punishment—extinction sessions. A discrimination based on the punishment apparently had been formed. However, there was still a possibility that reinforcement—and not punishment—produced the observed difference in rates, since reinforcement occurred several times in the one type of session but never in the other. The longest interval in the 2-minute VI schedule was 5 minutes; therefore, if no reinforcement occurred by the 5th minute of a session, the probability of further reinforcement was zero. If a reinforcement did occur within the first 5 minutes of a session, the probability of additional reinforcement was 1.00. Because of the differential occurrence of reinforcement, the subjects conceivably could have formed a discrimination on this basis rather than on the basis of the presence or absence of punishment.

We tried to determine the role of punishment in controlling the responding by temporarily excluding reinforcement from the punishment sessions. Before reinforcement occurs, the only difference in the two types of sessions is the presence or absence of punishment. If reinforcement alone controls the rate, the level of responding should be low in both sessions. On the other hand, if the punishment controls the higher rate, the rate of responding should be higher under punishment. Figure 2 shows that the responding increased when the responses were punished, even though reinforcement was withheld. The pattern of responding was essentially the same as when reinforcement was provided; *i.e.*, the responding

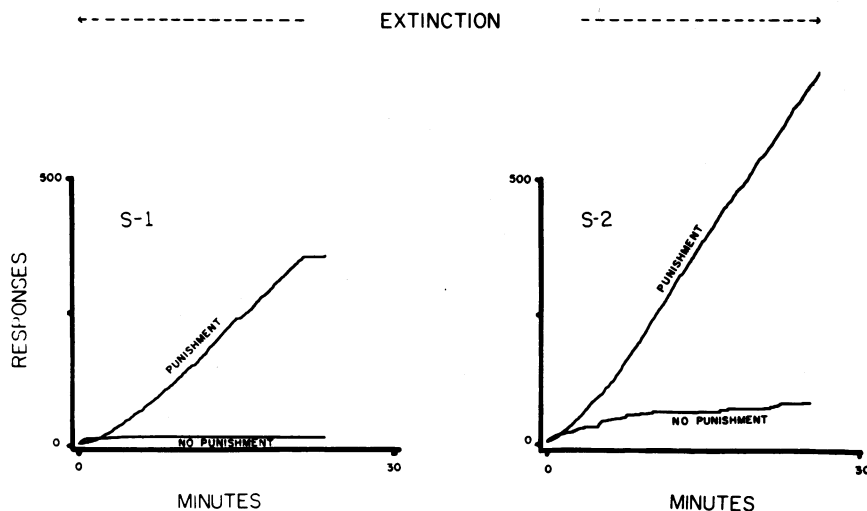


Fig. 2. The effect of punishment on responding after the punishment had been paired with reinforcement. A cumulative record from a punishment session is superimposed upon a cumulative record for a no-punishment session for each subject. Reinforcement was not provided in either session.

was positively accelerated. The same increase in responding under the punishment was observed on all five occasions of this procedure. Therefore, because of its differential pairing with reinforcement, the punishment in and of itself clearly had come to increase responding.

As a further assessment of the discriminative property of the punishment, 10-minute periods of punishment were introduced into the middle of the sessions that normally did not provide punishment. Punishment was administered to the first response after the end of the first hour of the session, and then to all subsequent responses during the next 10 minutes. No reinforcement was given at any time during these sessions. Figure 3 shows that the responding was at a near-zero rate before the introduction of punishment. The introduction of punishment produced a positive acceleration of responding, and was maintained at a moderate level throughout the remainder of the 10-minute period. When punishment was discontinued, responding decreased to the usual no-punishment level. A noteworthy aspect of the performance was the sudden, though short-lived, increase in rate when the punishment was discontinued (arrows, Fig. 3). This increase was observed the first two times that punishment was discontinued with this procedure, but was not clearly present on the subsequent trials.

These 10-minute punishment periods were introduced into five of the no-punishment, no-reinforcement sessions. Figure 4 contrasts the response rate during the 10-minute punishment periods with the rate (unpunished and unreinforced) that normally occurred in these sessions. This figure also provides an over-all view of the consistent low rate prevailing in the sessions which did not provide punishment.

In the results reported thus far, the electric shock always followed the response. Additional experiments demonstrated that the shock would increase responding even when pre-

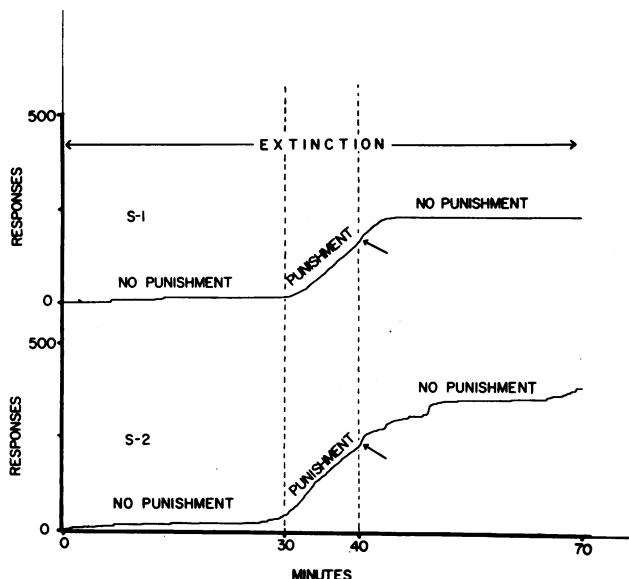


Fig. 3. Cumulative-response records of sessions in which a 10-minute punishment period was introduced. The records include a 30-minute period before the introduction of punishment and a 30-minute period after the punishment. The arrows point out the increase in rate that occurred immediately upon the termination of punishment.

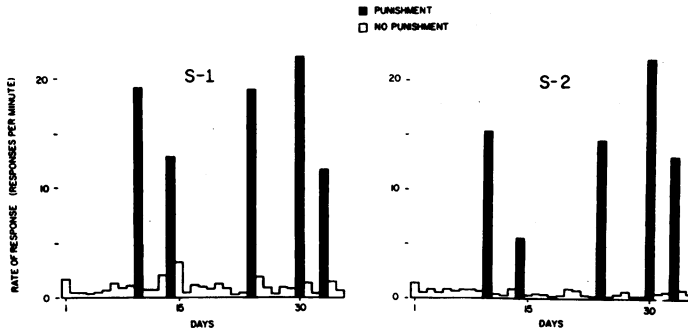


Fig. 4. The bar graph contrasts the response rate during the 10-minute punishment period that was introduced into the no-punishment sessions with the usual response rate in these sessions.

sented independently of the responses. Unavoidable shocks were scheduled to occur at various times in the sessions that did not ordinarily provide punishment. Figure 5 shows the effect of these unavoidable shocks. When these shocks were administered only occasionally, they typically elicited a slight flurry of responding shortly after their delivery. Similarly, when the shocks were delivered in fairly rapid succession, a moderate amount of responding resulted. This responding did not reach the magnitude observed when the shocks were response-produced, but was considerably greater than otherwise occurred during the no-punishment sessions. It may be noted that the responses elicited by the unavoidable shock were not punished and hence produced the condition associated with extinction.

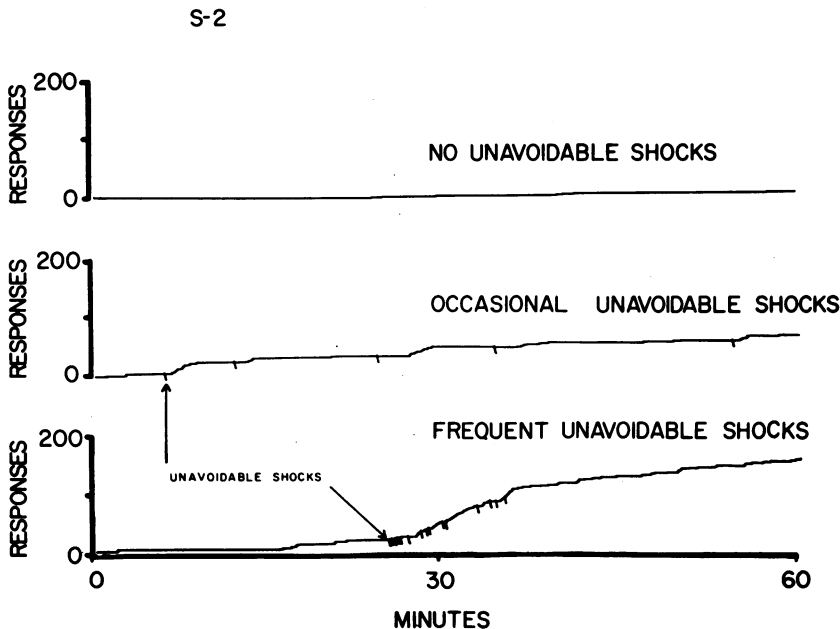


Fig. 5. Cumulative-response records of sessions in which A, no shocks were administered; B, unavoidable shocks were occasionally presented independently of the subject response; and C, unavoidable shocks were administered frequently during a 10-minute period.

Therefore, the responding produced by unavoidable shocks could not be expected to be so high as that produced by punishment.

The present results demonstrate that punishment will increase response rate when it has been paired with reinforcement. A third subject was studied to determine whether punishment would also *decrease* the response rate when it was paired with *extinction*. In pairing punishment with extinction, certain ambiguities arise. A stimulus that has been associated with extinction decreases response rate when that stimulus is presented. An aversive stimulus that follows a response ordinarily has this same effect. If punishment is paired with extinction and the rate decreases, it is difficult to determine whether the discriminative or the aversive property of the punishment produced the decrement. Because of this, a very low-intensity shock was used in order to minimize the aversive property of the punishment. Figure 6 (upper section) shows that a 20-volt A. C. shock has little or no aversive effect. The stable rate that developed when each response was punished was essentially the same as the rate when the responses were not punished.

This subject was placed under conditions similar to those of the first two subjects, except that the punishment was paired with extinction. Two sessions were administered daily. One

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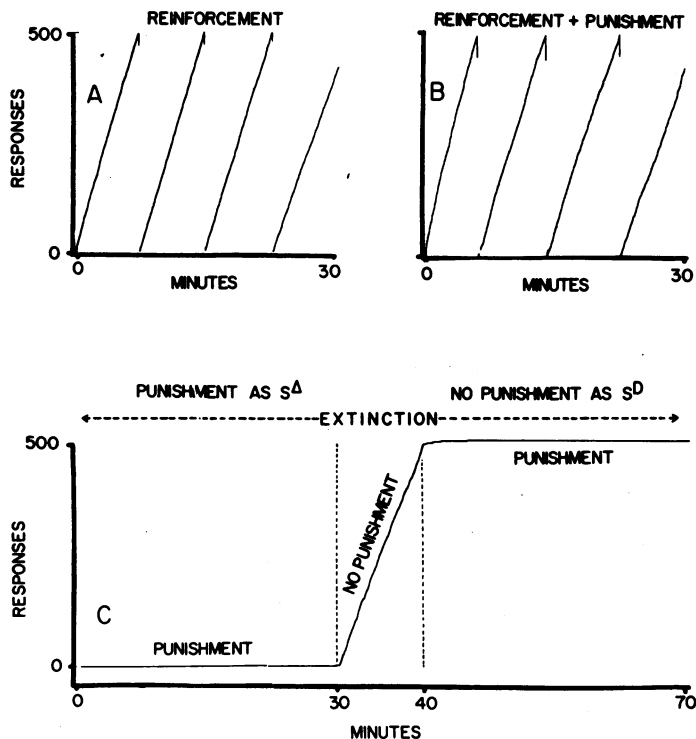


Fig. 6. Records of A, responding on a 2-minute VI reinforcement schedule without punishment; B, responding on a 2-minute VI reinforcement schedule with mild punishment for each response; and C, the effect of removing the mild punishment for a 10-minute period after the mild punishment had been paired with extinction and the absence of punishment had been paired with reinforcement.

session, 30 minutes long, paired the absence of punishment with the 2-minute VI reinforcement. The other session, 2 hours long, paired the 20-volt punishment with the absence of reinforcement. After several weeks, the response rate dropped to a low level in the sessions that paired punishment and extinction, but remained high in the sessions that paired the absence of punishment and reinforcement. When punishment was temporarily eliminated from the 2-hour sessions that provided punishment and extinction, the response rate increased (lower section of Fig. 6). The punishment had come to control a low response rate simply because of its discriminative property.

#### DISCUSSION

These experiments demonstrate that a relatively severe punishment can increase responding, and a nonaversive punishment can greatly reduce responding. Such results are contrary to what would be expected from the aversive property of the punishing stimulus. However, the anomalous results are clarified if one considers the other consequences of the responding. The severe punishment came to increase responding only after it had been selectively paired with reinforcement. The nonaversive punishment came to reduce responding only after it had been selectively paired with extinction. This procedure of selectively pairing a stimulus (in this case, the presence or absence of punishment) with reinforcement is the usual procedure for establishing a discrimination. This discriminative property that the punishment acquired produced the apparent anomaly. Indeed, the discriminative property came to exert an even greater effect on responding than did the aversive property.

The fact that punishment does not always suppress responding is often taken as evidence that punishment is an ineffective method of controlling behavior. However, in such cases the discriminative properties the punishment may have acquired should be considered. For example, experiments by Meunzinger (1934) have shown that correct maze responses (*i.e.*, those responses that are reinforced) are learned more quickly if they are punished. The punishment in this case is explicitly paired with reinforcement. Faster learning can be expected because the stimulus (punishment) is delivered immediately upon completion of the correct response. Another example of the alleged ineffectiveness of punishment is the finding (Estes, 1944) that punishment does not reduce the number of responses required for extinction. In these experiments, punishment was initiated at the same time that extinction was begun, so that the punishment is associated with extinction. The termination of punishment reinstated the stimulus situation associated with reinforcement. The discriminative property of this absence of punishment is sufficient to account for the increase of responding that was observed.

These discriminative properties of punishment may also account for some of the anomalous effects of punishment that are observed outside the laboratory. In situations where the consequences of behavior are not explicitly arranged, accidental contingencies may occur. These accidental contingencies may be inadvertently overlooked, and yet they may play an important part in determining behavior. For example, one might be *more* disposed to supply reinforcement to an individual following administration of punishment, in a sense to try to "make up" for the punishment. If so, the punishment would be (inadvertently) paired with reinforcement and it could be expected to acquire a discriminative property. Thus, the severe punishment would be ineffective as a deterrent. On the other hand, one might be *less* disposed to supply reinforcement after punishing. A slap on the wrist, a frown, or a shout would appear to be only mildly aversive—if at all. However, if one were less inclined to

reinforce after such mild punishment, then these events would become associated with extinction. In this instance, a trivial degree of punishment would be quite effective as a deterrent of behavior.

### SUMMARY

This experiment investigated the discriminative properties of punishment. It was found that when a severe punishment was differentially paired with reinforcement, punishment served to increase responding. Conversely, when an otherwise ineffective punishment was paired with extinction, punishment came to decrease responding. These discriminative properties of punishment are an explanation for a number of ambiguous findings in experiments on punishment.

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